

## CLAIMS

What is claimed is:

1. A polycentric prosthetic knee joint for use in connecting an upper leg prosthesis to a lower prosthetic leg comprising:

5 a housing with an upper joining section for connection with the upper leg prosthesis, and a lower section having an arcuate channel therein with a bumper at the forward portion of said channel;

a forward link having a first end pivotable about a first center of rotation on the lower section of the housing, a pin protruding from the forward link into the  
10 arcuate channel, and a second end pivotable about a second center of rotation on a chassis connected to the lower prosthetic leg;

a rear link having a front end pivotable about a third center of rotation located on the housing rearward of the first center of rotation, and a second end pivotable about a fourth center of rotation located on the chassis rearward of the second  
15 center of rotation;

wherein the bumper in the channel restrains the pin on the forward link against forward movement for up to between 10° and 20° of forward flexion by the prosthetic knee joint.

2. The prosthetic knee joint of claim 1 wherein the bumper is secured in place by a bumper cover mounted over a forward portion of the bumper in the channel, and the  
20 bumper cover serves as a hard stop against the pin on the forward link from more than between 10° to 20° of forward flexion..

3. The prosthetic knee joint of claim 1 wherein the lower portion of the housing defines a rotary chamber with forward and rearward ends and containing hydraulic fluid.

4. The prosthetic knee joint of claim 3 wherein the first end of the forward link is connected to a rotatable shaft mounted in an upper portion of the rotary chamber for rotation therewith.

5. The prosthetic knee joint of claim 4 wherein a paddle generally interfitted with the rotary chamber is mounted to the rotatable shaft and is adapted for reciprocable rotary movement with the rotatable shaft within the rotary chamber wherein the axis of rotation of the rotatable shaft is in the upper portion of the rotary chamber and rotary movement of the paddle is substantially in a lower portion of the rotary chamber.

6. The polycentric prosthetic knee joint of claim 3 wherein:

a rotatable paddle assembly having a rotatable shaft is mounted intermediate the forward and rearward ends of the chamber, said paddle interfitted within the chamber and being adapted for reciprocable rotary movement between the forward end and the rearward end of the chamber;

a first channel within the rotatable paddle assembly permits unidirectional flow of hydraulic fluid only from the forward end of the chamber to the rearward end of the chamber; and

a second channel within the rotatable paddle assembly permits unidirectional flow of hydraulic fluid only from the rearward end of the chamber to the forward end of the chamber.

7. The rotary hydraulic chamber assembly of claim 6 wherein a back valve in the first channel prevents the flow of hydraulic fluid from the rearward end of the chamber to the forward end of the chamber.

8. The rotary hydraulic chamber assembly of claim 6 wherein an adjustable flow control valve controls the rate at which hydraulic fluid may flow through the first channel from the forward end of the chamber to the rearward end of the chamber.

9. A rotary hydraulic chamber assembly for use in a prosthetic joint connecting an upper leg prosthesis to a lower prosthetic limb comprising:

a housing defining an upper joining section for connection to the upper leg prosthesis and a lower rotary chamber containing hydraulic fluid;

a rotatable shaft mounted in an upper portion of the rotary chamber;

a paddle mounted to the rotatable shaft, generally interfitting with the rotary chamber, and adapted for reciprocable rotary movement with the rotatable shaft within the rotary chamber;

wherein the arc of rotation of the paddle is generally through a lower portion of the rotary chamber, below an axis of rotation of the rotatable shaft.

10. The rotary hydraulic chamber assembly of claim 9 wherein the distance from the center of rotation of the rotatable shaft to the top of the upper joining section is less than 2.5 centimeters.

11. The rotary hydraulic chamber assembly of claim 9 wherein a link has a first end connected to the rotatable shaft for rotation therewith, and a second end in communication with the lower prosthetic limb.

12. The rotary hydraulic chamber assembly of claim 9 wherein the upper joining section is a dovetail joint that slideably engages directly with the upper leg prosthesis

13. The rotary hydraulic chamber assembly of claim 9 wherein the rotary chamber has a forward and a rearward end with the paddle and rotatable shaft being mounted

intermediate the forward and rearward ends of the chamber, such that a first channel within the paddle and rotatable shaft permits unidirectional flow of hydraulic fluid only from the forward end of the chamber to the rearward end of the chamber; and a second channel within the paddle and rotatable shaft permits unidirectional flow of hydraulic fluid only from the rearward end of the chamber to the forward end of the chamber.

14. The rotary hydraulic chamber assembly of claim 13 wherein a back valve in the first channel prevents the flow of hydraulic fluid from the rearward end of the chamber to the forward end of the chamber.

15. The rotary hydraulic chamber assembly of claim 14 where the back valve is a check ball.

16. The rotary hydraulic chamber assembly of claim 13 wherein an adjustable flow control valve controls the rate at which hydraulic fluid may flow through the first channel from the forward end of the chamber to the rearward end of the chamber.

17. The rotary hydraulic chamber assembly of claim 16 wherein the adjustable flow control valve is a choke.

18. A polycentric prosthetic knee joint for use in connecting an upper leg prosthesis to a lower prosthetic leg comprising:

a housing with an upper joining section for connection with the upper leg prosthesis and a lower section;

a forward link having a first end pivotable about a first center of rotation on the lower section of the housing and a second end pivotable about a second center of rotation on a chassis connected to the lower prosthetic leg;

a rear link having a first end pivotable about a third center of rotation located on the housing rearward of the first center of rotation, and a second end pivotable about a fourth center of rotation located on the chassis rearward of the second center of rotation;

5 a lever having a first end in communication with the rear link and a second end in communication with a barrel mounted for rotation within the chassis;

an extension assist mechanism having a tensile member with a first tensile member end connected to the rotatable barrel, a tensile member body passing through a spring with a proximal end fixedly received in the chassis, and a second  
10 tensile member end connected a distal end of the spring extending away from the joint;

wherein motion of the rear link relative to the fourth center of rotation causes the barrel to rotate and retract a portion of the tensile member toward the joint thereby compressing the spring.

15 19. The polycentric prosthetic knee joint of claim 18 wherein the lower section of the housing defines a rotary chamber with forward and rearward ends therein and containing hydraulic fluid, and further comprises a rotatable paddle assembly having a rotatable shaft mounted intermediate the forward and rearward ends of the chamber, said shaft having a paddle extending therefrom, the paddle interfitting within the chamber and  
20 being adapted for reciprocable rotary movement between the forward and rearward ends of the chamber.

20. The polycentric prosthetic knee assembly of claim 19 wherein the rotatable paddle assembly further comprises:

a first channel within the rotatable paddle assembly permitting uni-directional flow of hydraulic fluid only from the forward end of the chamber to the rearward end of the chamber; and

a second channel within the rotatable paddle assembly permitting uni-directional flow of hydraulic fluid only from the rearward end of the chamber to the forward end of the chamber.

21. An improved rotary hydraulic chamber assembly for use in a prosthetic joint comprising:

a housing defining a rotary chamber with forward and rearward ends therein and containing hydraulic fluid;

a rotatable paddle assembly having a rotatable shaft mounted intermediate the forward and rearward ends of the chamber, said paddle interfitting within the chamber and being adapted for reciprocable rotary movement between the forward end and the rearward end of the chamber;

a first channel within the rotatable paddle assembly permitting uni-directional flow of hydraulic fluid only from the forward end of the chamber to the rearward end of the chamber; and

a second channel within the rotatable paddle assembly permitting uni-directional flow of hydraulic fluid only from the rearward end of the chamber to the forward end of the chamber.

22. The rotary hydraulic chamber assembly of claim 21 wherein a back valve in the first channel prevents the flow of hydraulic fluid from the rearward end of the chamber to the forward end of the chamber.

23. The rotary hydraulic chamber assembly of claim 22 wherein the back valve is a check ball.

24. The rotary hydraulic chamber assembly of claim 21 wherein an adjustable flow control valve controls the rate at which hydraulic fluid may flow through the first channel from the forward end of the chamber to the rearward end of the chamber.

25. The rotary hydraulic chamber assembly of claim 24 wherein the adjustable flow control valve is a choke.

26. The rotary hydraulic chamber assembly of claim 24 wherein the adjustable flow control valve is mounted within the rotatable shaft.

27. The improved rotary hydraulic chamber assembly of claim 21 wherein the exterior of the housing has a channel grooved therein in proximity to the rotary chamber.

28. The improved rotary hydraulic chamber assembly of claim 21 wherein the rotatable shaft is mounted in an upper portion of the rotary chamber thereby defining an axis of rotation for the paddle assembly; and

the reciprocable rotary movement of the paddle is generally below the axis of rotation.

29. The rotary hydraulic chamber assembly of claim 28 wherein a link has a first end connected to the rotatable shaft for rotation therewith, and a second end in communication with a lower prosthetic limb.

30. The rotary hydraulic chamber assembly of claim 28 wherein the housing further defines an upper joining section that slideably engages with an upper leg prosthesis.

31. A polycentric prosthetic knee joint for use in connecting an upper leg prosthesis to a lower prosthetic leg comprising:

a housing with an upper joining section for connection with the upper leg prosthesis, and a lower section having an arcuate channel therein with a bumper at the forward portion of said channel;

a forward link having a first end pivotable about a first center of rotation on the lower section of the housing, a pin protruding from the forward link into the arcuate channel, and a second end pivotable about a second center of rotation on a chassis connected to the lower prosthetic leg;

a rear link having a front end pivotable about a third center of rotation located on the housing rearward of the first center of rotation, and a second end pivotable about a fourth center of rotation located on the chassis rearward of the second center of rotation said bumper at the forward portion of the channel restraining the pin on the forward link against greater than about 15° of forward flexion by the prosthetic knee joint;

a lever having a first end in communication with the rear link and a second end in communication with a barrel mounted for rotation within the chassis;

an extension assist mechanism having a cable with a first cable end connected to the rotatable barrel, a cable body passing through a spring with a proximal spring end fixedly received in the chassis, and a second cable end connected to a distal spring end extending away from the joint, such that motion of the rear link relative to the fourth center of rotation causes the barrel to rotate and retract a portion of the cable toward the joint thereby compressing the spring;

the lower section of the housing defining a rotary chamber with forward and rearward ends therein and containing hydraulic fluid;



a rotatable paddle assembly having a rotatable shaft mounted intermediate the forward and rearward ends of the chamber, and a paddle mounted to the rotatable shaft, generally interfitted with the rotary chamber, and adapted for reciprocable rotary movement about the rotatable shaft within the rotary chamber;

5 a first channel within the rotatable paddle assembly permitting uni-directional flow of hydraulic fluid only from the forward end of the chamber to the rearward end of the chamber; and

10 a second channel within the rotatable paddle assembly permitting uni-directional flow of hydraulic fluid only from the rearward end of the chamber to the forward end of the chamber;

wherein the rotatable shaft is mounted in an upper portion of the rotary chamber and the arc of rotation of the paddle is generally opposite the rotatable shaft from the upper joining section.